PAPER • OPEN ACCESS

e-Learning Development on Basic Chemical Law Materials in Senior High School (SMA/MA) to Improve High Order Thinking Skill Ability

View the article online for updates and enhancements.

e-Learning Development on Basic Chemical Law Materials in Senior High School (SMA/MA) to Improve High Order Thinking Skill Ability

Trayda Afrianti[1], Rahadian Zainul*[2]

[1]Chemistry Education Postgraduate Student, Universitas Negeri Padang
[2]Chemistry Department, Universitas Negeri Padang

*rahadianzmsiphd@fmipa.unp.ac.id

Abstract. This research aims to develop e-learning for learning Chemistry, Law of Basic Chemistry, for Senior High Schools (SMA/MA). The method used is Borg and Gail. E-learning product development using the Moodle 3.75 application. The stage in the development of this research is the content and construct validity of the product being developed. The result obtained is an e-learning product of Basic Chemistry Laws which has very high content and construct validity. From the results of the content validation, it was obtained 0.98 each for Guidelines and information; 0.88 for Content / material; and 0.87 for Evaluation. From this section, it can be seen that the content validity has a very high interpretation. From the results of the construct validity includes guidance and information; Program Performance; and Systematics, Aesthetics and Design principles respectively 0.84; 0.84; and 0.76. This section looks very high, except for the systematic, aesthetic and design aspects which are still in the high category. These results conclude that e-learning products have very high validity to be used as learning materials for Chemistry in Senior High Schools (SMA) and Madrasah Aliyah (MA), especially in the material of Basic Chemistry Laws.

1. Introduction

Chemistry is the study of the structure (structure) of matter and the changes that matter experiences in natural processes and in planned experimental processes. Through chemistry, we recognize the composition (composition) of substances and the use of chemical substances, both natural and artificial, and recognize important processes in living things, including our own bodies [1]. The study requires 3 levels of representation, namely macroscopic, submicroscopic and symbolic. This effort can be done by determining media and learning resources that prioritize the principle that students actively seek to explore their abilities.

The 2013 revised curriculum for 2018 continues to make improvements with the aim of students being able to improve higher-order thinking skills. This is in accordance with the skills that students must have in the 4.0 era. When viewed from an international survey conducted by PISA and TIMSS, the quality of education in Indonesia is still far behind the international average. Education and learning in Indonesia must be able to help students develop their abilities and potentials, especially in increasing higher-order thinking skills.

Technological developments have reached the time of revolution 4.0. One learning type that is currently developing and in the 4.0 era is blended learning. This learning model integrates face-to-face and distance learning with online sources [2]. Through the various types of features offered by the Learning Management System (LMS), the Moodle type should be able to explore the abilities of students. Using blended learning,

students are required to be more active in learning. Students in the class act as a learning center, so that the class is not rigid. Blended model of chemistry learning is able to develop higher order thinking skills.

Blended Learning model of learning has developed very rapidly. This is indicated by the presence of various recent researches that have been developed by several researchers, including stating that learning using blended learning is able to correct misconceptions, has independence and high interest and better thinking skills [3].

Brookhart states that: "higher-order thinking ability is (1) higher-order thinking at the top of Bloom's cognitive taxonomy, (2) the teaching goals behind the cognitive taxonomy that can equip learners to transfer knowledge, (3) being able to think means that participants students are able to apply the knowledge and skills they develop during learning in new contexts "[4]. High order thinking skills (HOTS) are abstract abilities that exist in the cognitive realm which include the ability to analyze, evaluate and be creative [5].

2. Methodology

This type of research is research and development. The resulting product is the development of a blended learning model. The Dick & Carey development design consists of the following 9 steps: Research and data collection; Planning; Development of a draft product; Testing the validity; Revised trial results; Practicality trials; Revised practicality trial results; Blended learning products are produced (valid and practical); and Product Implementation (effectiveness). The 9 research steps above are combined with the Borg and Gall design which are grouped into 4 stages, namely (1) introduction, (2) planning & development, (3) evaluation & revision (4) implementation. However, it can only be done up to stage 3 as depicted in Figure 1.
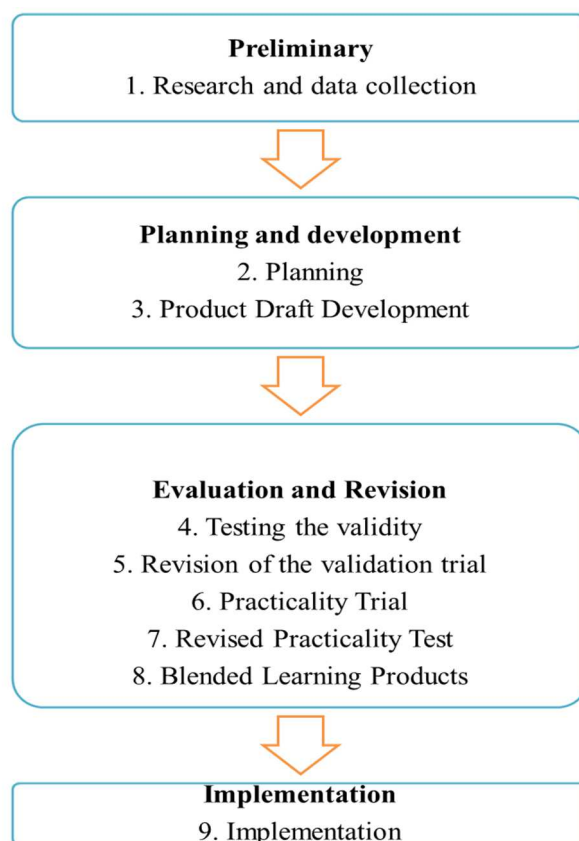

Preliminary
1. Research and data collection

Planning and development
2. Planning
3. Product Draft Development

Evaluation and Revision
4. Testing the validity
5. Revision of the validation trial
6. Practicality Trial
7. Revised Practicality Test
8. Blended Learning Products

Implementation
9. Implementation

Figure 1.Steps of Blended Learning Development Research

The analysis technique of content validity, construct and practicality is based on modified categorical judgments [6]. In categorical judgments, the validator is given a statement to then give an assessment of each of these statements. The sheet given is in the form of a questionnaire and at the end it is given the opportunity for the validator to decide the results of the assessment that has been given.

The validator's assessment of each statement was analyzed using the Kappa Cohen formula, where at the end of the processing a kappa moment was obtained.

$$moment\ kappa\ (k) = \frac{P - Pe}{1 - Pe}$$

Information:

k = kappa moment which shows the validity of the product

P = realized proportion, calculated by dividing the number of values given by the validator by the maximum value

Pe = unrealized proportion, calculated by means of the maximum value minus the total value given by the validator divided by the maximum value

Table 1.Categories of Decisions based on Kappa Moment (k) [6]

Intervals	Category
0,81 – 1,00	Very high
0,61 – 0,80	High
0,41 – 0,60	moderate
0,21 – 0,40	Low
0,01 – 0,20	Very low
≤ 0,00	Very low

The practicality / acceptability analysis technique is the same as the content and construct validation sheet analysis. The practicality / acceptability sheet assessment was obtained from the provision of teacher response questionnaires and student response questionnaires which were also analyzed using the Cohen Kappa formula.

3. Result and Discussion

This research resulted in e-learning moodle for the learning process. This e-learning is combined with face-to-face learning so that it is said to be blended learning. The product development combines the 9 stages of the Dick & Carey Model with the 4 stages of the Borg & Gall model as follows:

1. Introduction

Preliminary. This initial stage includes research and data collection through questionnaire data collection and interviews with 3 different high school teachers. The results show that there is no e-learning specifically for high school level chemistry and of course no one has combined it with face-to-face learning.

2. Planning and Development

Planning and Development. At this stage, design and develop e-learning products that will be used in learning as illustrated in Figure 4-6.

3. Evaluation and Revision

Validity and Practicality Test and Revision. At this stage the researcher conducted content validation testing and construct validation. Based on the results of data processing using kappa moment (k) where 0.91 is for content validation, while the construct validation is 0.81. These two results indicate that the resulting blended learning product has very high validity.

Table 2. Content Validation Results

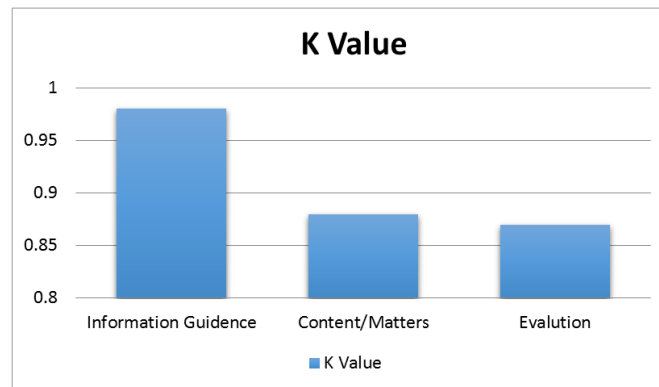| No	Rated aspect	K value	Category
1	Guides and information	0,98	Very high
2	Content	0,88	Very high
3	Evaluation	0,87	Very high

Figure 2. Graph of content validation results

Table 3. Results of construct validation4. Implementation

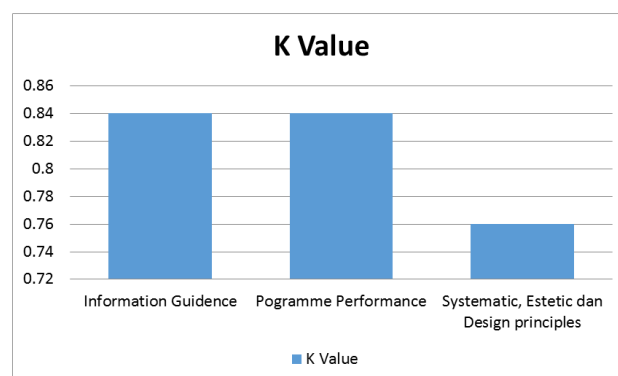| No.	Rated aspect	K value	Category
1	Guides and information	0,84	Very high
2	Program Performance	0,84	Very high
3	Average Value of Systematics, Aesthetics, Narrative and Audio Quality, Video / Video Quality, Power Point Quality, Module Quality, Book Quality, and Design in E-Learning	0,76	high

Figure 3. Graph of construct validation results

4. Implementation

Implementation. The implementation stage directs researchers to use e-learning products directly to students in the blended learning process as a test of effectiveness.

Based on the development that has been done, it is obtained learning products that can be accessed online (http://elearning.berkahprimasains.com/login/index.php) as shown in Figure 4.

Figure 4. Design of the e-learning page after logging in

This foreword is presented in words and also a video that has been connected to YouTube. Guidelines for use are provided in this e-learning in order to make it easier for teachers to fill out and design learning according to the material being studied by students. Then, provide ease of use for students to operate it. Competency achievement indicators need to be included in this e-learning as a learning standard that students must achieve. The more detailed knowing the direction of learning, it will make it easier for students to achieve material standards that must be understood in a more structured manner.

The lesson plan is important to include in this e-learning, because it provides directions for the activities carried out in each meeting. In addition, it makes participants learn the material earlier. If there is prior notification, the teacher will make an announcement on the announcements label under the RPP label.

Figure 5. Description of the Material

Furthermore, Figure 5 contains descriptions of material from various sources, namely modules, power points, videos and books. With the availability of various learning resources, it is able to provide convenience and solutions for students who have different learning styles. Learning designers must consider students, because they have different characteristics, one of which is learning styles. This learning style consists of verbal, visual, combination and so on [7]. The purpose of providing a discussion forum is to solve a problem, answer questions, add and understand the knowledge of students and to make decisions [8]. Therefore, in this discussion process the role of the teacher is very necessary in controlling the course of the discussion.

Figure 6. Assignments

Figures 6 have the same label icon which means they have the same function where students must upload the results of exercises and assignments in the form of photos, pdf and word. However, the difference is in the working time, namely the exercises carried out by students during learning hours and vice versa for task work. This daily test question is used to measure the learning outcomes of students. This question has been designed in the form of an objective question. In addition, students can find out the results of the questions they are able to answer[9-11].

4. Conclusion

From the results of the content validation, it was obtained 0.98 each for Guidelines and information; 0.88 for Content / material; and 0.87 for Evaluation. From this section, it can be seen that the content validity has a very high interpretation. From the results of the construct validity includes guidance and information; Program Performance; and Systematics, Aesthetics, Narrative and Audio Quality, Video / Video Quality, Power Point Quality, Module Quality, Book Quality, and Design in E-Learning are 0.84 respectively; 0.84; and 0.76. This section looks very high, except for the aspects of Systematics, Aesthetics, Narrative and Audio Quality, Video / Video Quality, Power Point Quality, Module Quality, Book Quality, and Design which are still in high categories. When viewed as a whole for content validation it has a value of 0.91 while 0.81 is for construct validation. These results conclude that e-learning products have very high validity to be used as learning materials for Chemistry in Senior High Schools and Madrasah Aliyah, especially in the material of Basic Chemistry Laws.

References

[1] Keenan, C.W. dan W. Kleinfelter. 1984. *Ilmu Kimia untuk Universitas Edisi ke-6.* Terjemahan Aloysius Hadyana Pudjaatmaka. Erlangga

[2] Harding, A., Kaczynski, D., & Wood, L. 2012. Evaluation of blended learning: analysis of qualitative data. *In Proceedings of The Australian Conference on Science and Mathematics Education (formerly UniServe Science Conference).* 11, 56-72

[3] Cetinkaya. 2016. Design Of Personalized Blended Learning Environments Based On Web Assisted Modelling In Science Education. *Vol.5.No.4, Desember 2016, Pp.323-330.*

[4] Istiyono,dkk. 2014. Pengembangan Tes Kemampuan Berpikir Tingkat Tinggi Fisika (Pysthots) Peserta Didik SMA. *Jurnal Penelitian dan Evaluasi Pendidikan.* Vol 18, No 1.

[5] Anderson & Krathwhol. 2001. *A Taxonomy for Learning Teaching, and Assesing, A revision of Bloom's Taxonomy of Education Objectives.* New York: addison Wesley Lonman Inc.

[6] Boslaugh, Sarah dan Paul A. W. 2008. *Statistics in a Nutshell, a desktop quick reference.* Beijing, Cambridge, Famham, Köln, Sebastopol, Taipei,Tokyo: O'reilly.

[7] Smaldino,Sharon E. Russel James D. Heinich, Robert. Molenda, Michael. 2005. *Instructional Technology and Media For Learning. 8th*. Pearson: Merril Prentice Hall

[8] Mudlofir, Ali. 2016. *Desain Pembelajran INOVATIF*. Jakarta: Raja Grafindo Persada.

[9] Zainul, R., Adri, M., Wahyuningtyas, N., Wedi, A., Surahman, E., Aisyah, E. N., ... & Santoso, Y. 2020. Development of e-Learning Courses for Subjects about 'Learn and Learning'with Moodle-based for Prospective Teacher in Indonesia. In Journal of Physics: Conference Series (Vol. 1594, No. 1, p. 012023). IOP Publishing.

[10] Adri, M., Zainul, R., Wahyuningtyas, N., Wedi, A., Surahman, E., Aisyah, E. N., ... & Santoso, Y. 2020. Development of Content Learning System in Professional Education Subjects for Educational Institutions in Indonesia. In Journal of Physics: Conference Series (Vol. 1594, No. 1, p. 012022). IOP Publishing.

[11] Sriadhi, Khaerudin, Wahyuningtyas N, Darni, Zainul R, Adri M, et al. 2020. Development of Moodle-based Content Learning System in MKDK Student Development Subjects at LPTK in Indonesia. Journal of Physics: Conference Series;1594:012021.

[12] Dye KM, Stanton JD. 2017. Metacognition in Upper-Division Biology Students: Awareness Does Not Always Lead to Control. CBE life sciences education;16.

[13] Ahn H, Kim HY. 2015. Implementation and outcome evaluation of high-fidelity simulation scenarios to integrate cognitive and psychomotor skills for Korean nursing students. Nurse education today;35:706-11.

[14] Kuhn D, Pease M, Wirkala C. 2009. Coordinating the effects of multiple variables: a skill fundamental to scientific thinking. Journal of experimental child psychology;103:268-84.